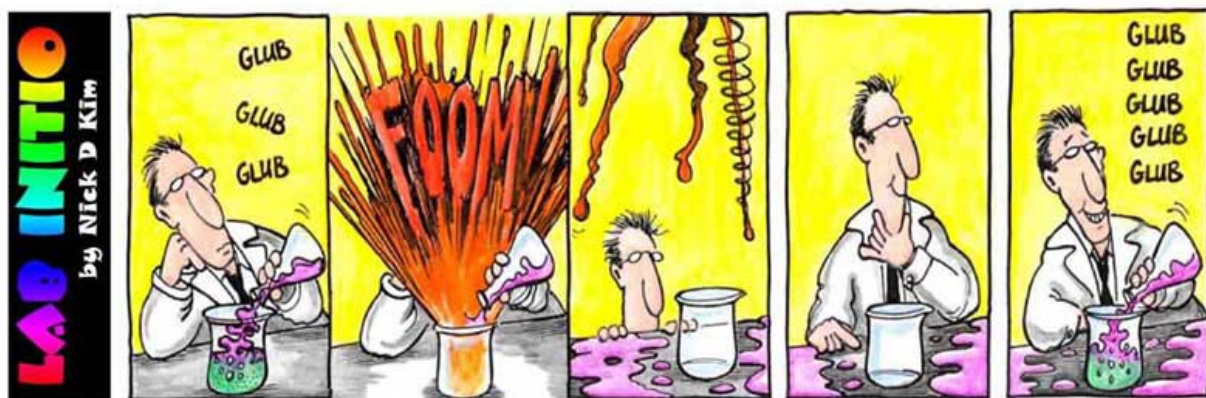


Chemistry 1

How to Solve Various Solution Problems



Name _____

Period _____ Date _____

Solving Percent solution problem

There are two major types of percent solution:

1. Calculating the percent by mass of solute to solution.
2. Calculating how much solute to make a solution of a given percent.

There are other problems but we're not going there!

Here is how it is done

1. What is the percent solution of a sugar solution that has 54 grams in 5600 g of solution?

using the formula from the reference sheet; the problem sets up like this

$$\% = \frac{54\text{g sugar}}{5600\text{g solution}} \times 100\% = 0.96\% \text{ or } 1\%$$

Other variations of this problem will not give you the mass of solution. The problem will give the specific gravity of the solution and the volume. These two numbers should be multiplied together to find the mass of the solution.

2. If 325 grams of sugar are dissolved in sufficient water to make 3800 mL of solution having a sp. gr. of 1.1764, what is the percentage concentration or the solution?

a) mass of solution = 3800 mL \times 1.1764 = 4470.3g solution

b) $\% = \frac{325\text{g}}{4470.3\text{g}} \times 100\% = 0.07\%$

The second form of the problem will ask how much solute is needed to make a solution of a specific percent.

3. How many grams of sodium chloride will be needed to make 550 g of 1.25 % solution?

$$1.25\% = \frac{x}{550\text{g}} \times 100\% = 6.88\text{g NaCl}$$

Percent Solution by Mass problems

Solve the following problems **showing ALL work**.

1. What percent by mass is a solution of KCl if 25g of KCl is in 175g of solution?
2. What percent by mass is a solution of NaCl if 48g of NaCl is in 290g of solution?
3. Calculate the weight of table salt needed to make 970 grams of a 4.00 % solution.
4. How many grams of solute are in 2200 grams of a 9.00% solution?
5. When 700 grams of a 3.0% solution of boric acid are crystallized, what weight of boric acid crystals is formed? Assume complete recovery.

6. An aqueous solution contains 42% by mass ethanol. What mass of ethanol is present in 250g of solution?

7. An aqueous solution contains 700g water and 45g sodium hydroxide. What is the percent by mass of sodium hydroxide?

8. Calculate the weight of sodium hydroxide in 1liter of a 50.0% solution. The density of the solution is 1.53 g per ml.

9. If the density of a solution of potassium hydroxide is 1.28 g per mL and it is a 29% solution, how many grams of KOH are in 1.0 liter of solution?

10. If 470.6 grams of sugar are dissolved in sufficient water to make 1.0 liter of solution having a sp. gr. of 1.1764, what is the percentage concentration or the solution?

11. If vinegar has a specific gravity of 1.0055 and is a 5.00% solution of acetic acid, calculate the weight of the solute in 1.00 liter.

12. A 70.0% sucrose solution has a density of 1.35 grams per ml. Calculate the weight of sucrose dissolved in 1.00 liter of this solution.

13. Find the weight of sodium chloride which is crystallized when 2000 ml of a 20% sodium chloride solution, sp. gr. = 1.148, is evaporated to dryness.

14. A 4 g sugar cube (Sucrose: $C_{12}H_{22}O_{11}$) is dissolved in a 350 ml teacup of 80 °C water. What is the percent composition by mass of the sugar solution?

Given: Density of water at 80 °C = 0.975 g/ml

15. What masses of potassium chloride and water are needed to make 250g of 5.00% solution?

Chemistry I: Solving Molality Problems

The formulae for molality problems are:

$$m = \frac{\left(\frac{\#g}{mm} \right)}{kg} \quad \text{or} \quad m = \frac{mol}{kg}$$

There are 3 types of problems:

1. the simplest type:
 - a. What is the molality of a solution that has 3 moles of KCl in 5000 g of water?

$$b. \quad m = \frac{3 \text{ mol KCl}}{5 \text{ kg}} = 0.6 \text{ m KCl}$$

2. to calculate the number of grams of solute to make a solution of known molal concentration

- a. How many grams of NaOH are needed to make a 2.5 m solution with 1500 grams of water?

$$b. \quad 2.5 \text{ m} = \frac{\left(\frac{x}{40 \text{ g}} \right)}{1.5 \text{ kg}} = 150 \text{ g NaOH}$$

3. To calculate the molality of a solution given the amount of compound and the mass of water?

- a. What is the molality (m) of a solution that contains 270 grams of MgSO_4 in 3000 grams of water?

$$b. \quad m = \frac{\left(\frac{270 \text{ g}}{120 \text{ g}} \right)}{3 \text{ kg}} = 0.75 \text{ m MgSO}_4$$

Molality Problems

Show the complete set-up using all necessary conversion factors. Be sure to include the correct unit.

1. Four moles of a solute are dissolved in 2000 g of water. Calculate the molality of the solution obtained.
2. Find the molality of a solution that was made by dissolving 10 moles of a solute in 4000 g of water.

Calculate the molality of the following solutions :

3. 3 moles of solute in 1500 g H_2O
4. 2 moles of solute in 5000 g H_2O
5. 10.5 moles of solute in 3500 g H_2O
6. What is the molality of a solution containing 56 g KOH in 2000 g H_2O ?
7. Find the molality of a solution prepared by dissolving 112 g KOH in 4000 g H_2O .
8. 60 g NaOH in 5000 g H_2O
9. 20 g NaOH in 2500 g H_2O

10. 30 g acetic acid ($\text{HC}_2\text{H}_3\text{O}_2$) in 2000 g H_2O

11. 80 g NaOH in 2000 g H_2O ?

12. 310 g ethylene glycol, $\text{C}_2\text{H}_4(\text{OH})_2$, in 2.0 kg H_2O ?

13. 4.6 g glycerol, $\text{C}_3\text{H}_5(\text{OH})_3$, in 200 g H_2O ?

How many grams of solute must be dissolved in:

14. 2000 g of H_2O to prepare a 3.00 molal solution of NaOH?

15. 1800 g of H_2O to prepare a 3.00 molal solution of $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ (MW = 342g)?

16. 500 g of H_2O to prepare a 3.0 molal solution of KOH?

17. What is the molality of a solution containing 31 g ethylene glycol in 2.0 kg H_2O ?

18. How many grams of ethanol (ethyl alcohol) must be dissolved in 1.0 kg of H₂O to prepare a 0.50 molal solution?
19. A solution is composed of 30 g of NaOH in 500 g H₂O. What is its molality?
20. Calculate the molality of a solution prepared by dissolving 15.0 g acetic acid in 400 g H₂O.

Solving Molarity Problems

The formulae for molarity problems are:

$$M = \frac{\left(\frac{\#g}{mm} \right)}{L} \quad \text{or} \quad M = \frac{\text{mol}}{L}$$

There are 3 types of problems:

1. the simplest type:
 - a. What is the molarity of a solution that has 3 moles of KCl in 5000 mL of solution?

b.
$$M = \frac{3 \text{ mol KCl}}{5 \text{ L}} = 0.6 \text{ M KCl}$$

2. to calculate the number of grams of solute to make a solution of known molar concentration

- a. How many grams of NaOH are needed to make 1500 mL of 2.5 M solution?

b.
$$2.5 \text{ M} = \frac{\left(\frac{x}{40 \text{ g}} \right)}{1.5 \text{ L}} = 159 \text{ g NaOH}$$

3. To calculate the molarity of a solution given the amount of compound and the volume of solution.

- a. What is the molarity (M) of a solution that contains 270 grams of MgSO_4 in 3000 mL of solution?

b.
$$\text{M} = \frac{\left(\frac{270 \text{ g}}{120 \text{ g}} \right)}{3 \text{ L}} = 0.75 \text{ M MgSO}_4$$

Molarity Problems

1. Sea water contains roughly 28.0 g of NaCl per liter. What is the molarity of sodium chloride in sea water?
2. What is the molarity of 245.0 g of H_2SO_4 dissolved in 1.00 L of solution?
3. What is the molarity of 5.30 g of Na_2CO_3 dissolved in 400.0 mL solution?

4. What is the molarity of 5.00 g of NaOH in 750.0 mL of solution?
5. How many moles of Na_2CO_3 are there in 10.0 L of 2.0 M solution?
6. How many moles of Na_2CO_3 are in 10.0 mL of a 2.0 M solution?
7. How many moles of NaCl are contained in 100.0 mL of a 0.20 M solution?
8. What weight (in grams) of NaCl would be contained in problem 7?
9. What weight (in grams) of H_2SO_4 would be needed to make 750.0 mL of 2.00 M solution?
10. What volume (in mL) of 18.0 M H_2SO_4 is needed to contain 2.45 g H_2SO_4 ?

11. What volume (in mL) of 12.0 M HCl is needed to contain 3.00 moles of HCl?
12. How many grams of $\text{Ca}(\text{OH})_2$ are needed to make 100.0 mL of 0.250 M solution?
13. What is the molarity of a solution made by dissolving 20.0 g of H_3PO_4 in 50.0 mL of solution?
14. What weight (in grams) of KCl is there in 2.50 liters of 0.50 M KCl solution?
15. What is the molarity of a solution containing 12.0 g of NaOH in 250.0 mL of solution?
16. Determine the molarity of these solutions:
- a) 4.67 moles of Li_2SO_3 dissolved to make 2.04 liters of solution.
 - b) 0.629 moles of Al_2O_3 to make 1.500 liters of solution.
 - c) 4.783 grams of Na_2CO_3 to make 10.00 liters of solution.
 - d) 0.897 grams of $(\text{NH}_4)_2\text{CO}_3$ to make 250 mL of solution.
 - e) 0.0348 grams of PbCl_2 to form 45.0 mL of solution.

17. Determine the number of moles of solute to prepare these solutions:

a) 2.35 liters of a 2.00 M $\text{Cu}(\text{NO}_3)_2$ solution.

b) 16.00 mL of a 0.415-molar $\text{Pb}(\text{NO}_3)_2$ solution.

c) 3.00 L of a 0.500 M MgCO_3 solution.

d) 6.20 L of a 3.76-molar Na_2O solution.

18. Determine the grams of solute to prepare these solutions:

a) 0.289 liters of a 0.00300 M $\text{Cu}(\text{NO}_3)_2$ solution.

b) 16.00 milliliters of a 5.90-molar $\text{Pb}(\text{NO}_3)_2$ solution.

c) 508 mL of a 2.75-molar NaF solution.

d) 6.20 L of a 3.76-molar Na_2O solution.

e) 0.500 L of a 1.00 M KCl solution.

f) 4.35 L of a 3.50 M CaCl_2 solution.

19. Determine the final volume of these solutions:

a) 4.67 moles of Li_2SO_3 dissolved to make a 3.89 M solution.

b) 4.907 moles of Al_2O_3 to make a 0.500 M solution.

c) 0.783 grams of Na_2CO_3 to make a 0.348 M solution.

d) 8.97 grams of $(\text{NH}_4)_2\text{CO}_3$ to make a 0.250-molar solution.

e) 48.00 grams of PbCl_2 to form a 5.0-molar solution.